Do public sector reforms get rusty?
An empirical analysis on privatization of solid waste collection

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Abstract:

Recent empirical evidence, from countries in the European Union in particular, are much more ambiguous on the costs savings from private production of local public services than previous literature used to be. In this paper, an explanatory model of factors driving costs in solid waste collection is specified and estimated, using a sample on Spanish municipalities. Indeed, this paper presents some first empirical parametrical evidence on this issue for this country. Results obtained in the estimation indicate no significant effects of the mode of production (public/private) on costs borne by municipalities. As we find no effect of the mode of production on costs, we put forward two hypotheses. On one hand, progressive concentration and bidding competition decrease in the privatized sector may have outweighed eventual gains coming from privatization. On the other hand, the threat that privatization may represent for public unit managers may have stimulated them to search for alternative management reforms. In this sense, this paper introduces for the first time in the empirical literature factors such as (1) the existence of inter-municipal cooperation; and (2) whether the reform is old or new when analyzing the factors explaining the municipal costs for this service. The results suggest the inter-municipal cooperation and recent privatization are associated with lower costs. Instead, old privatization is not associated with lower costs.

Keywords: privatization, contracting-out, local government.
JEL Codes: L33, R51, H72

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INTRODUCTION

Recent empirical evidence on privatization[1] of local public services is more ambiguous on the costs savings from private production than previous literature used to be. Probably, solid waste collection has generated more empirical literature on the relation between privatization and costs than any other service. When surveys like Domberger and Rimmer (1994), Domberger and Jensen (1997), Savas (2000) and Hodge (2000) appeared, there were wide consensus on the positive relation between privatization and cost savings, as most robust empirical papers on the issue arrived to that conclusion.[2] However, recent empirical evidence is becoming much less conclusive, since the number of studies not finding any significant relation between mode of production and costs is growing: Callan and Thomas (2001) in Massachusetts, Dijkgraaf and Gradus (2003) in the Netherlands, and Ohlsson (2003) in Sweden.

Kodrzycki (1994) and Ballard and Warner (2000) have pointed out that initial savings given by privatization tend to disappear over time, and this seems to be true for small municipalities in particular. Perhaps, privatization was a beneficial reform at the time it was first implemented. But one must consider the possibility that it could be a kind of reform that is not a permanent optimum. Indeed, in his analysis on economic reform processes, Hirschman (1971) had already pointed out that there are no permanent optimal measures. After undertaking the reform, dynamic interaction between market and government keeps working. Hence, Hirschman suggested focusing on finding a good periodical policy switching pattern, rather than focusing on searching for a permanent optimal policy.

This paper studies the relation between solid waste collection costs and the mode of production, either public or private. In order to assess this relation we specify a model and run multivariate regressions using a sample of Catalonian municipalities. This case is interesting because of the *comarca,* the equivalent of county level service districts in Catalonia. This unit provides smaller municipal governments the opportunity to pool resources and achieve economies of scale for services like refuse collection.

[1] There are significant differences between transferring firms or services to the private sector and contracting out. However, Vickers and Yarrow (1991) consider the contracting out of services previously provided by the public sector as another type of privatization. Although it does not imply the sale of physical assets, it consists of the sale of a franchise contract. The contractor appropriates any financial surplus derived from the service, and the appropriation of this profit is central to the idea of property.

[2] Other meta-analysis of privatization studies as Boyne (1998) did not find consistent evidence of cost savings.

Results of the empirical analysis indicate that there are no significant effects of the mode of production on costs paid for by municipalities. From the results of this kind of cross-section analysis, many authors conclude that privatization does (or does not) reduce costs, according to the empirical results for the variable mode of production. However, a cross-section analysis cannot logically tell us whether privatization reduces costs or not. The analysis of the particular effects of privatization should take into account the first year in which every single municipality contracted out, thus studying the change in the service costs from pre-privatization to post-privatization. Because of lack of data over time, multivariate analysis is not suitable for this type of study. Hence, what we find throughout our analysis has nothing to do with what happened when privatization took place. What our empirical evidence actually shows is simply that the mode of production does not appear to have influence on the differences in costs paid by municipalities for the refuse collection service.

In order to explain these results, we analyze the alternative management reforms and the post-privatization market dynamics. The economic theories of organization have long identified the importance of a competitive market place. In fact, transaction cost theory centers around the risks of contracting for services in the absence of a competitive market place or for services that are likely to become monopolized. The paper shows that, on one hand, the high degree of market concentration may weaken competition for contracts. This may make it difficult for governments to obtain potential benefits from contracting-out. On the other hand, results on cost comparison between inter-municipal cooperation cases and isolated municipal production cases reveal that cooperation appears to be a proper tool for taking profit of potential scale economies and reduce costs in low-population municipalities. Since inter-municipal cooperation aggregation is more frequent in municipalities with public production, we can conclude that inter-municipal cooperation is used as an alternative to privatization when undertaking reforms.

The research strategy is the following. First, we summarize theoretical background and international empirical evidence on the effects of contracting-out and privatization on solid waste collection costs. Second, a model is developed and estimated explaining solid waste collection costs in Spain. Within this context, we assess the effect of the mode of production on costs. Third, we use analysis of inter-municipal cooperation and post-privatization market dynamics to help explain the results obtained. Finally, the main conclusions and their implications for public policy are drawn.

PRIVATIZATION OF SOLID WASTE COLLECTION: THEORETICAL FRAMEWORK AND INTERNATIONAL EMPIRICAL EVIDENCE

As already mentioned, consensus on the positive relation between privatization and cost savings has prevailed for a long time. Despite this, many governments have been reluctant to privatize and keep using public production. Why should they forego the potential cost savings from privatization?

The theoretical analysis of privatization and contracting-out offers an answer to this question by using the wide concept of transaction costs, which include administration costs as well as incomplete contract costs. Sappington and Stiglitz (1987) theoretically analyze the choice between public and private production taking into account transaction costs. The main factor when choosing the production mode is a function of the transaction costs level derived from authority delegation under asymmetric information. Paroush and Prager (1999) extend the theoretical analysis on the choice of production mode with transaction costs by allowing contractor deception. Brown and Potoski (2003) offer evidence on monitoring frequency that governments take when risk of contract failure is high.

In recent years many political-economy works have looked for an empirical answer to the question above and have studied the factors that induce or deter privatization: McGuire, Ohsfeldt and Van Cott (1987), Dubin and Navarro (1988), Lopez-de-Silanes, Schleifer, and Vishny (1997), Glaeser (2001) and Warner and Hebdon (2001) in the USA; Bel and Miralles (2003) in Spain; Dijkgraaf, Gradus and Melenberg (2003) in The Netherlands; Christoffersen and Paldam (2003) in Denmark, and Ohlsson (2003) in Sweden.

As already pointed out by Warner and Hefetz (2001), empirical evidence offers little support to the government failure explanation. Although some studies find that strength or weakness of trade unions is relevant for the privatization decision [e.g. McGuire, Ohsfeld, and Van Cott (1987), and Lopez-de-Silanes, Schleifer, and Vishny (1997)], a more general finding is that there are not ideological biases influencing politician's decision. Thus, this decision is pragmatic rather than ideological.

Many empirical studies have analyzed the relation between privatization and costs in solid waste collection. Table 1. summarizes a wide sample of econometric regression results.[3] It is quite clear that up to the late nineties, evidence overwhelmingly supported the positive

[3] There exist other assessments using DEA techniques. In the United Kingdom, Cubbin, Domberger and Meadowcroft (1987) conclude that physical productivity growth explain most of cost reduction both in private production and in public production retained by means of a tendering process. Bosch, Pedraja and Suárez-Pandiello (2000) do not find any significant productivity difference between public and private production, using DEA with a 75 -Spanish-municipality sample. Less relevance is deserved to other studies that just compare costs directly, not taking into account control variables [e.g. Savas (1977, 1981) and McDavid (2000, 2001)].

relation between contracting-out and private production, and service cost reduction. It is only Collins and Downes (1977), and in some sense Stevens (1978) and Dubin and Navarro (1988), that cast doubt in this almost-unanimous conclusion..

Table 1. Empirical evidence on solid waste collection privatization and costs

Study	Country	Evidence
Kemper & Quigley 1976	USA	Private individual collection is 30 percent more expensive than local monopoly. Within local monopoly, contracting out is 20 percent cheaper then in-house production.
Kitchen 1976	Canada	In-house production is more expensive than contracting out.
Collins & Downes, 1977	USA	No significant difference between public and private production
Pommerehne & Frey 1977	Switzerland	Private production is cheaper than public production.
Stevens 1978	USA	Comparison between public and private production does not generally yield significant differences. In largest cities private production is cheaper
McDavid 1985	Canada	Cost reduction when private sector obtains the contract is larger than public-private mix.
Domberger, Meadowcroft & Thompson 1986	UK	Contracting out reduces costs by 20 percent, with no changes in service quality.
Tickner & McDavid 1986	Canada	Contracting out reduces costs.
Millward 1986	Switzerland	Contracting out reduces costs by 20 percent.
Berenyi & Stevens 1988	USA	Contracting out reduces costs between 0 and 48 percent.
Dubin & Navarro, 1988	USA	Monopoly, public or private, is cheaper than market. Private monopoly is the cost minimizing option.
Buck & Chaundy 1992	UK	Contracting out reduces costs by 33 percent.
Szymansky & Wilkins 1993	UK	Contracting out reduces costs.
Szymanski 1996	UK	Contracting out reduces costs. Cost reduction by 20 per cent with private firms and by 10 per cent when contracts awarded to in-house teams.
Reeves & Barrow 2000	Ireland	Cost reduction with private firms.
Callan & Thomas 2001	USA	No significant difference between public and private production
Dijkgraaf & Gradus 2003	Netherlands	Contracting out reduces costs, but there is no significant difference between public and private production.
Ohlsson 2003	Sweden	Public production is 6 percent cheaper than private production.

Source: Own elaboration. Information on Collins and Downes (1977), Pommerehne and Frey (1977), Millward (1986), Berenyi and Stevens (1988) and Buck and Chaundy (1992) has been obtained from Hodge (2000) and Savas (2000).

Nevertheless, the most recent papers (in bold type, Table 1) find much more diverse results: 1) cost improvements with private production in Ireland (Reeves and Barrow, 2000); 2) non-significant differences between public and private production in Massachusetts (Callan and Thomas, 2001) and the Netherlands (Dijkgraaf and Gradus, 2003); 3) public production even cheaper in Sweden (Ohlsson, 2003). This has brought ambiguity to the cost comparison between private and public production,[4] and induces discussion on the possibility that continuously reduced competition in concession contests and alternative reforms in public service production may have led to differences in costs for the municipality to vanish.

[4] It is worth considering that national and local contexts may affect results. Studies in Table 1 published prior to 2000 deal with privatization in Canada, Switzerland, the United Kingdom and the USA. Those appeared since 2000 deal with Ireland, the Netherlands, Sweden and the USA. In these countries legislative frameworks and public/private dealings vary significantly from those in Canada, Switzerland and the United Kingdom. Although the USA appears in both categories, all the cited studies prior to 2000 that cast doubt about the benefits of contracting-out waste collection deal with the USA.

As already mentioned above, empirical studies on the decision to privatize show that politicians are rather pragmatic. Hence, it may well happen that many of them be reluctant to privatization simply because they do not foresee relevant cost savings, above all when governments have available a menu of other management reform alternatives. Warner and Hebdon (2001) emphasize the idea that privatization is just one of the tools the politician has in order to face a growing quality demand. Hence, more attention has been paid to the ability to reform public units that produce services given the competitive threat that the private sector imposes.[5]

DATA AND RESEARCH DESIGN

We have collected data from a survey specifically designed to undertake this research and sent to every municipality in the Spanish region of Catalonia. This section presents first the methodology applied to obtain the data and the municipalities' response level. Secondly, we show results describing solid waste collection structure in Catalonia.

The survey and sample signification

Data concerning municipal costs of the service, weekly collection frequency, and mode of production (public/private) has been obtained from the *Survey on local service production*, designed by University of Barcelona researchers, supervised by the School of Catalonian Public Administration (Regional Government of Catalonia), and completed by Catalonian municipalities. The enquiry had two phases. In a first stage, between May and October 2000, we obtained data about mode of production, frequency and inter-municipal cooperation, among other minor issues. In the second stage, developed between February and October 2002, we send additional queries to municipalities with a population over 1000 having already replied to a previous survey. At this stage, we asked for data on settled waste collection costs in 2000. Meanwhile, we sent a complete survey asking for all the information to those municipalities that had not completed the first survey. After completing the survey, 186 municipalities had sent answers with enough, reliable information.

Table A-1 on the Appendix depicts general sample characteristics. The sample contains 44 per cent of municipalities in Catalonia with a population over 1,000, and 80 per cent of municipalities with a population over 20,000. It also includes half of medium size municipalities, which have a population between 5,000 and 20,000 inhabitants. Finally, sample has 35 per cent of Catalonian municipalities that have a population between 1,000 and 5,000 inhabitants, a percentage that is quite high for this type of municipalities. The level of

[5] Also, contracting back to in-house delivery has emerged as another alternative reflecting the complexity of public service provision (Hefetz and Warner, 2004).

representation of the sample considering the population covered is higher than the "number of municipalities" level. This is because the response frequency is increasing in the municipality population. Population included in the sample represents almost 79 per cent of the total Catalonian population.

Concerning other issues, 186 municipalities included in the sample cumulate 2.49 million waste tones. This figure represents almost 75 per cent of the total refuse generated in Catalonia in 2000. Recycling generated in the sample municipalities is 12.6 per cent of the total municipalities' waste. For the whole of Catalonia, this percentage is 12.5.

SOLID WASTE COLLECTION: AN EMPIRICAL STUDY

The model

The basic function for solid waste collection costs can be represented as

$$C = f(Q, P, X, Z) \tag{1}$$

C is the costs of the service for the municipality. They are mainly determined by the output Q, input prices P, some other characteristics X of the output and non-controllable characteristics Z already affecting the service. Explanatory variables considered here are Q= Output generated by the municipality; PR= Percentage of recycling on total waste; W= Labor costs; F= Frequency of service; D= Population density; T= Tourism intensity; L= Existence of landfill in the municipality; PROD= Mode of production (public/private). Bel (2003) contains a more detailed discussion on the model and the variables.

The analysis is based on most relevant previous works: Hirsch (1965), Kitchen (1976), Stevens (1978), Domberger, Meadowcroft and Thompson (1986), Dubin and Navarro (1988), Callan and Thomas (2001), Dijkgraaf and Gradus (2003) and Ohlsson (2003). Besides cost function determination and specific assessment of scale economies, this study considers general waste and recycling in a separate way, a task only carried out to this date in Callan and Thomas (2001) and Dijkgraaf and Gradus (2003). Moreover, and differing from cited papers, particular attention is paid to the "seasonality" implied by tourism activity, particularly relevant in the geographical context of this analysis. Finally, a multivariate analysis is done in order to assess to what extent (if any) mode of production affects costs.

The dependent variable

The dependent variable is the refuse collection cost that the municipality has to pay for. This includes collection, transportation, and disposal and elimination.[6] Total cost of the service, *TC*, is specified as the dependent variable, as it is done in most of the relevant works in the literature available [Stevens (1978), Domberger, Meadowcroft and Thompson (1986), Callan and Thomas (2001) and Dijkgraaf and Gradus (2003)].

Explanatory variables

1) Output (Q): The first explanatory variable is the quantity of waste generated in the municipality, expressed in kilos. Results in the literature mostly indicate existence of slight scale economies in low-populated municipalities [Stevens (1978), Dubin and Navarro (1988)] or no existence at all [Hirsch (1965), Callan and Thomas (2001)], and hardly any work reported scale economies for highly populated municipalities. Since previous results on scale economies are mixed, there is not a precise hypothesis drawn from the results.

2) Percentage of recycling (PR): Data allows for distinguishing between waste for elimination and recycled waste. This enables us to analyze the impact of the latter on total costs. We expect that costs increase with the percentage of recycling (*PR*).[7]

3) Wage level (WL): Wage variability among territories may have an influence on costs paid for by the municipalities. There is not non-aggregated information on wages in this service, but it is much likely that workers already working in some province (Catalonia has four provinces: Barcelona, Girona, Lleida and Tarragona) live in the same province, and it is plausible to think that sector-specific territorial wage differences are quite similar to general territorial wage differences. In his analysis on local public services in USA, Ladd (1992) uses the State wage level as an explanatory variable. For the Spanish case, Alcaide and Alcaide (2003) offer estimates of labor costs at the province level. We use these estimates to specify the variable wage level *(WL*). This variable takes in each municipality the average provincial value. As in Stevens (1978) and Domberger, Meadowcroft and Thompson (1986), we expect that labor costs and service costs are directly related. Therefore, the variable will have a significant and positive effect on costs.

4) Frequency (*FREQ*): Number of days per week when collection is done. We expect A significant positive effect on costs following previous results [Stevens (1978), Domberger, Meadowcroft and Thompson (1986), Dubin and Navarro (1988), Callan and Thomas (2001)].

[6] It does not include street cleansing, clearly different in its economic nature. Impossibility in separating refuse collection cost from street cleansing one has led to skip observations from the sample regarding municipalities that, having given a unique amount for both services altogether, were not able to disentangle the information.

[7] McDavid (2000, 2001) presents descriptive evidence in this sense.

5) Population density (*DENS*): We take population density, measured in inhabitants per square kilometer, as a municipality density indicator. This variable has also been used in demand studies for this service (i.e. Kinnaman and Fullerton, 2000). The expected effect of this variable is ambiguous. On the one hand, a higher population density offers the opportunity to collect more solid waste per dustbin. On the other hand, waste collection is mainly a transportation activity. Transportation time is quite sensitive to congestion and traffic-light regulation, usually common in densely populated areas.[8] Hence, it is difficult to predict what the density effect on costs will be. This is consistent with the ambiguity that results in the literature offer: no density economies (Stevens, 1978); diseconomies of density (Kitchen, 1976); economies of density [Domberger, Meadowcroft and Thompson (1986)]; mixed results [Dubin and Navarro (1988), Callan and Thomas (2001)]

6) Tourism (*TO*): There are no preceding examples of the use of this variable. However, the importance of this activity in the geographical context of this empirical analysis makes its inclusion advisable. Tourism activity in Catalonia (Spain) has a pronounced seasonal component in the summer as well as in the winter. Generated solid waste data reflects somehow this tourism effect. Nevertheless, the data fails to reflect the instability of the production structure due to tourism seasonality. This means that peak seasons require additional efforts, i.e. changes in frequency, using more inputs, etc. Thus, the effect of tourism intensity on costs may be positive and significant. We take as a measure the "tourism index" for the year 2000, published by La Caixa (the main savings bank in Spain).

7) Landfill in the municipality (*LAND*): Transportation costs between the municipality where collection takes place and the disposal place, represents an important part of the service costs. As in Callan and Thomas (2001), we consider a dummy variable showing existence of landfill in the municipality. It then takes value 1 if the landfill is in the municipality and 0 otherwise. We expect the effect of this variable to be negative.

8) Mode of production (*PROD*): In order to assess the influence of the different ways to produce the service on its costs we use the variable *PROD* as a dummy that takes value 1 if a private firm produces the service and 0 if a public unit or firm do so. Its expected effect is ambiguous. As was pointed out, some multivariate studies find a negative relation between private production and costs, while others do not find conclusive evidence at all.

Data and sources

All data employed in the empirical analysis refers to the year 2000. We have obtained information on solid waste generated by each municipality from the Catalonian Government

[8] Bodkin and Conklin (1971) suggested this duality in the effects of density on local services costs, and

web page (http://www.gencat.es), and it contains data on quantity of common refuse as well as on recycled waste. Data for existing landfills and the municipalities where they are come from the same source as well. We have obtained information on municipal population and surface from the Spanish National Statistic Institute web page (http://www.ine.es) and the Catalonia Statistic Institute (http://www.idescat.es). We have used Alcaide and Alcaide (2003) estimates for Labor costs. The savings bank La Caixa has published Tourism indicator data for year 2000 in the *Economic Yearbook 2002* (http://www.lacaixa.es). Data on costs, frequency, mode of production and inter-municipal cooperation has been obtained from the *Survey on Local Service Production* (Universitat de Barcelona and Regional Government of Catalonia), mentioned above. Table 2 presents a brief depiction for most relevant variables.

Table 2. Basic statistics [average (and standard deviation)] for relevant variables.

Inhabitants	Municipalities	Cost (euros)	Refuse (Kilos)	percent of recycling	Density	Frequency (times per week)	Tourism
Whole sample	186	955,665 (4,544,265)	13,402,459 (56,945,641)	11.17 (7.67)	1,170.22 (2,791.61)	6.05 (1.20)	64.65 (439.58)
1000 a 19999	147	221,582 (281,863)	3,503,225 (3,712,996)	10.79 (8.35)	305.25 (396.74)	5.88 (1.27)	20,93 (91,42)
≥ 20000	39	3,722,593 (9,501,965)	50,714,959 (118,010,421)	12.59 (4.01)	4,430.47 (4,850.97)	6.69 (0.47)	229.41 (934.53)

Source: Own on the basis of sources cited in the text.

The estimated equation

From the cost function [1] a model for total refuse collection costs paid for by the municipality is specified as follows:

$$TC_i = \beta_0 \, Q_i^{\beta 1} \, PR_i^{\beta 2} \, DENS_i^{\beta 3} \, FREQ_i^{\beta 4} \, WL_i^{\beta 5} \, e^{(\beta 6 TOi + \beta 7 \, LANDi + \beta 8 \, PRODi + ui)} \qquad (2)$$

All the variables have been defined above. Model specification has taken into account that the tourism indicator takes value zero in some cases, so that logarithmic transformation is not possible. As in Stevens (1978) and Domberger et al. (1986), we have estimated the double logarithmic form of the following equation:

$$\log TC_i = \beta_0 + \beta_1 \log Q_i + \beta_2 \log PR_i + \beta_3 \log DENS_i + \beta_4 \log FREQ_i + \beta_5 \log WL_i + \\ + \beta_6 TO_i + \beta_7 LAND_i + \beta_8 PROD_i + u_i \qquad (3)$$

Finally, and from previous experience in the literature, we think that there may be some concern with some questions related to municipality size. In cases where scale economies have been recognized [Stevens (1978), Dubin and Navarro (1988)], eventual disappearance has been observed from some critical municipality size. Additionally, Stevens (1978) and

Kitchen's (1976) empirical work considered it. Subsequent literature has obviated this issue.

Dubin and Navarro (1988) open a debate on the structural stability of the cost equation or on the eventual changes concerning population size. In order to study these issues, the sample has been split into three subgroups (municipalities up to 10,000 inhabitants, municipalities up to 20,000 inhabitants and municipalities with more than 20,000 inhabitants), and separate equations for each of them have been estimated. We have done Chow's test for structural change from the obtained results.

Empirical results

The results have been obtained from the estimation of the equations by using Intercooler Stata 6.0 statistic software. Robust White error estimation has been calculated to properly adjust coefficients signification. Table 3 shows obtained results for the aggregate sample as well as for the different subgroups.

Column 1 in table 3 presents results for the aggregate sample. These indicate that the explanatory power of the model is quite high, above 95 per cent. This result is common in studies taking the total cost as the endogenous variable, as Stevens (1978), Domberger, Meadowcroft and Thompson (1988) and Dijkgraaf and Gradus (2003). The F-test indicates that all variables are jointly significant at the 1 per cent level.

Quantity of waste has a very significant relation with costs, over 99 per cent confidence level, and its coefficient is slightly below 1. Nonetheless, rejecting the hypothesis of *no* scale economies, i.e. $\beta_1 \geq 1$, is not possible (a more detailed analysis is further shown in table 4 below). The percentage of recycling and the frequency of the service increase service cost and show a significant relation with the total cost, above the 99 per cent confidence level. Wage level has significant and positive relation with costs, above 95 per cent confidence level. Tourism has also a positive relation with costs, above 90 per cent confidence level. Landfill has cost-reducing effects and is significant, above the 99 per cent confidence level. Finally, population density does not show a significant relation with the costs. Neither does the mode of production (private/public).

Table 3 also shows results obtained from the estimation of the equations for different population size subgroups: up to 10,000 inhabitants (column 2) and up to 20,000 inhabitants (column 3). In both cases, the explanatory power is high and the whole equation is significant at the 1 per cent signification level. Results are quite similar to one another and to the aggregate-sample estimation. Quantity of solid waste, percentage of recycling, frequency of service, and wage level increase service cost, and are significant at the 99 per cent confidence level. Tourism also increases cost, at the 99 per cent confidence level in the up-to-10,000-inhabitant subgroup, although the confidence level is lower in the up-to-20,000-inhabitant

subgroup. Landfill in the municipality reduces costs significantly, at the 99 per cent confidence level. Furthermore, population density and mode of production do not show significant relation with the cost in any case.

Table 3: Empirical results from the estimation of total cost equation

Variable	Column 1 Coefficient	Column 2 (population<10000) Coefficient	Column 3 (population<20000) Coefficient	Column 4 (population>20000) Coefficient
Constant	-21.398** (-2.931)	-29.604*** (-3.770)	-22.960*** (-3.058)	5.089 (0.819)
Log Quantity	0.995*** (37.829)	0.900*** (21.450)	0.940*** (24.309)	0.942*** (21.167)
Log Percent of recycled	0.110*** (3.899)	0.126*** (3.482)	0.109*** (3.876)	0.134*** (2.730)
Log Density	0.125 (0.614)	0.029 (1.146)	0.009 (0.364)	-0.021 (-0.885)
Log Frequency	0.365*** (4.229)	0.356*** (3.958)	0.391*** (4.241)	1.619*** (4.835)
Log Wage level	1.759** (2.407)	2.693*** (3.414)	1.988*** (2.633)	-0.999* (-1.727)
Tourism	0.00005* (1.659)	0.003*** (6.885)	0.0006 (1.554)	0.00004** (2.240)
Landfill	-0.405*** (-3.171)	-0.802*** (-4.725)	-0.609*** (-3.855)	-0.211*** (-4.819)
Production	-0.025 (-0.499)	0.041 (0.694)	-0.004 (-0.951)	0.094 (1.159)
R^2	0.972	0.928	0.942	0.981
Adjust R^2	0.971	0.923	0.940	0.976
F-Test	1041.74***	208.99***	264.81***	6144.43***
N	186	121	147	39

- In parentheses z-statistic with White estimation.
- Significantly different from zero at the 99 per cent (***), 95 per cent (**), and 90 per cent (*) confidence level.

Finally, column 4 in table 3 shows estimation results for highly populated municipalities (more than 20,000 inhabitants). The tables reveal differences for one variable when comparing them to the other estimations: The wage level has a negative effect in this sub-sample, although the confidence level is relatively low. This may be because there is low variability in the sub-sample, since 31 out of the 39 municipalities of population above 20,000 inhabitants belong to the province of Barcelona. Also, it may sound plausible that wages inter-provincial variation among cities be very low at this population level.[9]

[9] If average costs (unit cost per tone) are alternatively taken as the explained variable, the explanatory power becomes more moderate. R-squared are 0.335 (aggregate sample), 0.480 (municipalities up to 10000 inhabitants), 0.377 (up to 20000 inhabitants) and 0.544 (over 20000 inhabitants). This result is similar to that of Dubin and Navarro (1988) and higher than the one in Ohlsson (2003), perhaps the ones who obtained most robust results among those that adopted average cost as endogenous variable. In all cases model adjustment is quite high, following the respective F-tests, and, logically, the coefficients and the statistic signification of the variables except for the quantity of generated waste are exactly identical to the ones shown in table 3.

Results obtained from the equation estimation reveal significant differences between highly populated municipalities and low populated ones. This suggests the existence of two equations. By using the Chow's proof, one can assess this structural change. Table A-2 in the appendix presents relevant results for this test. The obtained F is 3.10. Hence, we can reject the null hypothesis of no structural change at the 1 per cent level, and thus alternative hypothesis is assumed true: the equation is different for highly populated and low populated municipalities. Hence, it is advisable to analyze solid waste collection costs taking into account different municipality population levels, as done in this paper.

Analysis of scale economies existence

Table 4 presents results for the absence of scale economies (H_0: $\beta_1 \geq 1$) test. The analysis of a hypothesis of this kind calls for a one-tail test (Greene, 2000), as the alternative hypothesis is H_1: $\beta_1 < 1$, corresponding to scale economies. The null hypothesis cannot be rejected for both the aggregate sample and the high-population subgroup estimations. However, estimations for low populated municipalities present several differences. First, the coefficients on the quantity of waste are lower than in the other estimations. Second, it is possible to reject the null hypothesis of non-existence of economies of scale at the 99 per cent confidence level (up to 10000 inhabitants) and the 90 per cent level (up to 20000 inhabitants).

Table 4. Scale economies analysis

Equation	N	Coefficient	z-statistic
All municipalities	186	0.995	-0.185
Municipalities over 20000 inhabitants	39	0.942	-1.203
Municipalities below 20000 inhabitants	147	0.940*	-1.552
Municipalities below 10000 inhabitants	121	0.900***	-2.371

- z-statistic from the robust estimation. Confidence levels for rejecting the hypothesis (H_0: $\beta_1 \geq 1$) are: 99 per cent (***), 95 per cent (**) and 90 per cent (*).

The results concerning scale economies coincide with the results from Dubin and Navarro (1988), Callan and Thomas (2001) and Dijkgraaf and Gradus (2003) in the sense that no economies of scale are found in the aggregate sample. They also coincide with the results from Stevens (1978) and Dubin and Navarro (1988) in finding scale economies in low-populated municipalities, economies that become weaker as long as population increases, above all with more than 20,000 inhabitants. Moreover, they agree with Stevens (1978) in the sense that, inside the relevant scale economies existence rank, its intensity decreases with respect to municipality size. It is observed in table 4 that the β_1 coefficient gets closer to 1 when including higher populated municipalities in the estimation.

Scale economies in less populated municipalities are very low, as in Dubin and Navarro (1988). They are lower and less significant than those obtained in Stevens (1978). In order to explain these differences, one can think of a growing potentiality for other alternative reforms to have taken place in our context and moment, exploiting these scale economies. We have already pointed out that inter-municipal cooperation is frequent, particularly in small municipalities already keeping public production. These reforms may have had a substantial effect on the exploitation of scale economies. This would explain that, although the analysis reveals economies of scales, these are moderate and slightly significant ones.

ALTERNATIVE REFORMS, PRIVATIZATION AND COMPETITION: AN EXTENSION OF THE BASIC MODEL

Results obtained in our analysis show that the mode of production (public/private) does not have any effect on observed differences on costs paid for by the municipalities. This would have been a quite singular result in the context of the empirical papers published between the mid seventies and the late nineties. However, this result appears more and more frequently among the most recent empirical works on the issue. It is possible that the privatization decision have had cost-reduction effects just after it was implemented. Nevertheless, some dynamic factors may be reducing these effects in the long term.

Inter-municipal cooperation as an alternative for reform

Recent literature on public services reform (Warner and Hebdon, 2001) points out that analysis on privatization often lacks taking into account other reform policies apart from privatization itself. No privatizing is not the same as no reforming, as there are reform alternatives different to privatization that can contribute to improving efficiency in publicly produced services: increasing flexibility in public organization structure, inter-municipal cooperation, contracting back in, entrepreneurial behavior and cessation of services.

Contracting-out is as a way to exploit scale economies. Many municipalities have a size smaller than optimal for service production, and contracting out allows a private firm to produce the service in several municipalities in the same zone, already taking advantage of these scale economies. However, aggregating the service in districts wider than the municipality through inter-municipal cooperation allows for exploiting scale economies, with either public production or private.

Inter-municipal cooperation in solid waste sector is present all over Catalonia. Its most usual district delimitation is the “comarca”, which is roughly Spanish for *county*. Moreover, some municipalities create “inter-municipal communities” in order to aggregate the service in an optimal extension different to the county. Inter-municipal cooperation frequency is

different depending on municipality size, following the pattern of rural-urban differences already identified in Warner and Hefetz (2003): frequency of inter-municipal cooperation is a lot higher in low-populated municipalities than in highly populated ones.

From the information available on service cost for each municipality, we can compare average costs (euros per kilo) among municipalities depending on whether inter-municipal cooperation is used or not. Table 5 presents costs comparisons. In the whole sample, average costs in co-operating municipalities are 19.5 per cent lower than average costs in municipalities that do not co-operate. This cost difference is significant at the 1 per cent level.

Table 5. Average costs according to existence or absence of inter-municipal cooperation.

	Inter-municipal cooperation		Municipality		
Population	Average cost (euro/ton)	Cases	Average cost (euro/ton)	Cases	t-student
All municipalities	54.13 (15.33)	73	67.21 (19.51)	113	-5.096***
Population ≥ 20,000	73.42 (13.75)	4	70.00 (13.26)	35	0.473
Population < 20,000	53.01 (14.74)	69	65.96 (21.79)	78	-4.261***
Population <10,000	53.19 (14.97)	66	68.09 (23.75)	55	-4.033***

- Standard deviation in parentheses.
- *t-student* (***) significant at 1 per cent level (***); significant at 5 per cent level (**)

When dealing with municipalities of a population over 20,000 there are no significant average cost differences. This has to do with the decline of scale economies in this type of municipalities. Nevertheless, inter-municipal cooperation in less populated municipalities does have a significant relation with lower average costs. In the whole set of municipalities below 20,000 inhabitants, the average cost when co-operating is 19.6% per cent lower than when no inter-municipal cooperation is taken, and this difference is significant at the 1 per cent signification level. In the set of municipalities with a population under 10,000, average costs in cooperating municipalities are 21.9% lower, and the difference is statistically different from zero, at the 1 per cent level.

Based on the analysis above, it can be defined a new variable to enter the model specified in (2). We can define the variable *InterCoop* as a dummy variable that takes value 1 if the municipality is significantly involved in inter-municipal cooperation and 0 otherwise. We expect the effect of this variable to be significantly negative for the municipalities of low population, and non-significant for the highly populated municipalities. Now we specify the model for total refuse collection costs paid for by the municipality as follows:

$$TC_i = \beta_0 Q_i^{\beta 1} PR_i^{\beta 2} DENS_i^{\beta 3} FREQ_i^{\beta 4} WL_i^{\beta 5} e^{(\beta 6 TOi + + \beta 7 LANDi + \beta 8 PRODi + \beta 9 INTERCOOPi + ui)} \quad (4)$$

The table 6 presents the results obtained from the estimation of the new model. The results do not change significantly with respect to the results obtained above (see table 3). To avoid redundancies we only discuss on the new information obtained from the new specification. Concerning the new variable on inter-municipal cooperation (*InterCoop*), we find its coefficient negatively related with costs and highly significant, above the 99% confidence level, in the estimation for the aggregated sample.

Table 6: Empirical results from the estimation of total cost equation including the inter-municipal cooperation variable

Variable	Column 1 Coefficient	Column 2 (population<10000) Coefficient	Column 3 (population<20000) Coefficient	Column 4 (population>20000) Coefficient
Constant	-15.388** (-2.193)	-22.485*** (-2.963)	-15.997** (-2.192)	-5.598 (-0.933)
Log Quantity	0.974*** (38.574)	0.876*** (22.419)	0.908*** (24.843)	0.935*** (20.177)
Log Percent of recycled	0.119*** (4.526)	0.135*** (4.333)	0.118*** (4.761)	0.149*** (2.778)
Log Density	0.006 (0.295)	0.018 (0.790)	- 0.004 (- 0.165)	-0.025 (-1.030)
Log Frequency	0.323*** (3.698)	0.314*** (3.333)	0.350*** (3.666)	1.667*** (4.945)
Log Wage level	1.214* (1.737)	2.050*** (2.719)	1.371* (1.882)	-1.048* (-1.895)
Tourism	0.00006** (2.155)	0.003*** (6.103)	0.0006* (1.703)	0.00005** (2.277)
Landfill	-0.409*** (-3.224)	-0.821*** (-5.783)	-0.591*** (-3.586)	-0.225*** (-4.649)
Production	-0.071 (-1.482)	-0.037 (-0.652)	-0.066 (-1.239)	0.102 (1.235)
InterCoop	-0.185*** (-3.856)	-0.236*** (-4.620)	-0.226*** (-4.475)	-0.075 (-1.107)
R^2	0.974	0.939	0.949	0.982
Adjust R^2	0.973	0.934	0.945	0.976
F-Test	1068.76***	207.63***	268.49***	5073.14***
N	186	121	147	39

- In parentheses z-statistic with White estimation.
- Significantly different from zero at the 99 per cent (***), 95 per cent (**), and 90 per cent (*) confidence level.

When estimating the equation for the municipalities with low population (up to 10000, column 2; up to 20000, column 3) we find again that the coefficient for *InterCoop* is negative and highly significant, above the 99 per cent level. However, when estimating the model for the sub-sample of municipalities of population above 20000 we find a negative sign for *InterCoop*, as expected, but the coefficient does not significantly differ from 0.

To conclude, inter-municipal cooperation appears to be a proper formula to address scale economies and to reduce costs in municipalities with population below 20,000. This kind of service aggregation is generalized (87 per cent) in municipalities below 20,000 inhabitants already keeping public production. Its frequency in municipalities below 20,000 inhabitants having the service contracted out is 37 per cent, though. Taking into consideration both things, one can conclude that inter-municipal cooperation is often used as a cost-reducing tool that is alternative to privatization.[10]

Contracting out, collusion and competition conditions

Empirical literature on privatization is quite coincident in noticing that, from an efficiency point of view, effective competition *in* the field is even more important that firm's ownership structure. Ownership change improving effects are dependent on a good competition framework. This paper focuses on a kind of service that is monopolistic, so competition *for* the field is the central issue. In this context, the existence of lack-of-competition problems in bidding for contracts may be a serious obstacle for technical efficiency improvement reflected on firm's costs,[11] as well as for allocative efficiency, reflected on costs borne by municipalities.

Gomez-Lobo and Szymanski (2001) find that the number of firms bidding for refuse collection contract is negatively related to service costs. The *Survey* used in this research does not provide information on the number of firms bidding for every single contract. Nonetheless, it includes information on the identity of the firm holding the contract in the municipalities that had contracted out the service. In all these cases contracts were awarded to private firms, as public firms do not participate in bidding processes in our context of study. Hence, we can assess the distribution of firms in the 152 municipalities (82 per cent of the

[10] It must be noticed that inter-municipal cooperation does not preclude privatization; both are sometimes used simultaneously. This is the case of 43 municipalities in the sample with less than 20000 inhabitants having the service both supra-municipally aggregated and contracted out. This combination is also observed in four municipalities with population over 20000. Warner and Hebdon (2001) examined the mix of restructuring services and found that a mix of strategies is usually used to reform. Bel and Miralles (2003) and Miralles (2004) do not find an univocal relation between inter-municipal cooperation and privatization.

[11] Antonioli and Filippini (2002) study the cost structure of firms in solid waste collection sector in Italy, and find that public and private franchised monopoly are more efficient that side-by-side competition, and also that introducing competition for the contracts improves firms' efficiency.

sample) in which production is private. The total number of concessions is 155, as the city of Barcelona was split into four refuse collection districts before the last bidding process, so that Barcelona has four concessions instead of one.

Table A-3 in the appendix summarizes the results related to concession structure. A first look at the data shows a high concentration degree, following a number-of-concessions criterion as well as a quantity-of-collected-waste criterion. One firm, FCC, shares almost 30 per cent concessions and almost 50 per cent solid waste collected in the sample contracting-out municipalities. CESPA, the second firm in this sector, has 12 per cent concessions and 16 per cent collected refuse. In the other extreme, one quarter of the concessions (39) are allocated to single-contract-holder firms, and 13 per cent (20) to two-contract-holder firms. All this depicts a highly concentrated sector on one extreme, given accumulation of the main contracts in the hands of the main firms, and a high degree of small holdings in the other extreme. A more specific concentration analysis can be performed with some concentration indicators, widely used in the economic research:

* **Concentration rate**. It is defined as the cumulative market share of the first k firms: $CR_k = \sum_{i=1}^{k} X_i / X = \sum_{i=1}^{k} Q_i$, where X_i is i^{th}-firm's size, X total market size and Q_i i^{th}-firm's market share. This rate can be either calculated for the leading firm (CR_1), or it can be taken as a "marginal concentration rate", combining a given number of firms. In the latter case, the most usual indicator used in the literature is the one that includes the first four firms (CR_4).

* **Hirschman-Herfindhal Index (HH)**. It is defined as the sum of squared market shares: $HH = \sum_{i=1}^{n} Q_i^2$, where Q_i is defined as above and n is the total number of firms in the field. It is an index generally used in the literature. Its advantage over concentration rates consists on the fact that it takes into account the number of firms as well as the differences among them, as big firms are weighed high and small firms weighed low.

Table 7 presents results calculated (a) for the number of concessions and (b) for the quantity of waste collected. CR_1 and CR_4 rates show a very high concentration degree. As mentioned above, the market shares of the leading firm are almost 30 per cent (concessions) and 50 per cent (waste collected). Aggregating first four firms' market shares gives 50 per cent concessions and 75 per cent collected refuse. Following the four main types of market structure often used when analyzing the CR_4 index, concentration reaches level 1 (very high, above 60 per cent) with respect to the quantity of waste, and level 2 (high, between 40 and 60 per cent) with respect to the number of concessions.

Table 7: concentration indexes in solid waste sector

Variable	RC1	RC4	HH
Concessions (155)	0.2968	0.5097	0.1120
Waste collected	0.4686	0.7563	0.2583

Hirschman-Herfindhal Index is greater than 0.10 for concessions and is clearly above 0.20 for quantity of collected waste. Following the four types of market structure characterized in Besanko, Dranove and Shauley (2000), the market structure is a monopolistic competition for concessions (competition depends on product differentiation) and an oligopoly with respect to the quantity of waste (competition depends on firms' rivalry). Taking into account the limits in product differentiation in this sector, one can conclude from the observed structure that competition intensity is low and it crucially depends on firms' rivalry.

A more detailed analysis of private firms location in Catalonia offers additional reasons that offer concern about rivalry intensity among firms. Catalonia is administratively split into four provinces: Barcelona, Girona, Lleida and Tarragona. So a further step in the competition analysis is a disaggregate study on concentration indexes for each province. Table 8 shows the results. Analysis at province level shows that separate indexes are typically higher than the ones obtained for the whole sample. Lleida has a monopolistic structure de facto, while Tarragona shows a strong oligopolistic structure. Results for Barcelona also suggest higher concentration than in the whole sample in Catalonia.

Table 8: concentration indexes at provincial level

Province	Variable	RC1	RC4	HH
Barcelona	Concessions (85)	0.2588	0.5412	0.1089
	Waste collected	0.4511	0.8076	0.2600
Girona	Concessions (33)	0.2121	0.5152	0.0983
	Waste collected	0.3256	0.6854	0.1649
Lleida	Concessions (15)	0.8000	1.0000	0.6622
	Waste collected	0.8462	1.0000	0.7279
Tarragona	Concessions (22)	0.3636	0.7727	0.2149
	Waste collected	0.6139	0.9692	0.4430

To sum up, concentration levels in the waste collection sector are very high in Catalonia. Data presented by Reimer (1999) indicate that the five biggest firms in United Kingdom jointly shared 60 per cent of the contracts awarded to the private sector in this service. From our analysis we derive similar percentages for the whole sample in Catalonia, and for the

provinces of Barcelona and Girona, and clearly above them in Lleida and Tarragona. If we focus on the quantity of generated waste, concentration levels are even higher.

Contracting out is a dynamic process that typically converges from a competitive market structure to a monopolistic one (Sclar, 1997, 2000). Although bidding processes may have been competitive enough, the market becomes a bilateral monopoly just after the award of the contract. The contracted firm will try to keep control over the contract by means of an anti-competitive behavior against public and private firms. Foreseeing these threats, firms will try to secure contacts with politicians, and will additionally arrive to collusive agreements. Vickers and Yarrow (1991) point out the possibility of collusive behavior and progressive market concentration. To sum up, competition may become more important than ownership. This hypothesis can be used to explain the results obtained in the empirical analysis, focused on the solid waste service.

Following the hypothesis above, we should expect that the older the first process of contracting out in a municipality the higher the probability that the competition for the contract has decreased. Contrariwise, the newer the first experience of contracting in a municipality, the higher the degree of competition and, because of this, a better –negative- effect on costs paid by municipalities for the service. To check this hypothesis, we can define two new variables to enter the model specified in (4). We can define the variables (a) *OldPriv* as a dummy variable that takes value 1 if the municipality had her first privatization experience before 1990 and 0 otherwise, and (b) *NewPriv* as a dummy variable that takes value 1 if the municipality had her first privatization experience in 1990 or after, and 0 otherwise. Logically, we take out here the variable *Prod* from the model. When comparing the new variables with public production, we do not expect a negative relation between *OldPriv* and costs. On the contrary, we expect a negative relation between *NewPriv* and costs. In addition, we expect a negative relation between *NewPriv* and costs when compared with *Oldpriv*. Now we specify the model for total refuse collection costs paid for by the municipality as follows:

$$TC_i=\beta_0\ Q_i^{\beta 1}\ PR_i^{\beta 2}\ DENS_i^{\beta 3}\ FREQ_i^{\beta 4}\ WL_i^{\beta 5}\ e^{(\beta 6 TOi + + \beta 7\ LANDi + \beta 8\ OLPRIV\ i + \beta 9\ NEWPRIV\ i + \beta 10\ INTERCOOPi + ui)} \quad (5)$$

Table 9 presents the results obtained from the estimation of the new model.[12] The results are quite similar to those obtained above (see table 6).

Table 9 Empirical results from the estimation considering the time of first privatization

Variable	Column 1 Coefficient
Constant	-18.405** (-2.302)
Log Quantity	0.981*** (30.695)
Log Percent of recycled	0.132*** (3.378)
Log Density	-0.012 (-0.517)
Log Frequency	0.385*** (3.503)
Log Wage level	1.490* (1.880)
Tourism	0.00005** (2.257)
Landfill	-0.234*** (-3.197)
PrivOld	0.007 (0.099)
PrivNew	-0.133** (-2.417)
InterCoop	-0.141** (-2.191)
R^2	0.980
Adjust R^2	0.979
F-Test	1324.91***
N	125
Coef *PrivOld* – Coef *PrivNew*	0.140** (2.164)

- In parentheses z-statistic with White estimation.
- Significantly different from zero at 99 per cent (***), 95 per cent (**), and 90 per cent (*) confidence level.

Concerning the new variables, we find that costs in the municipalities with private production and recent reform (*NewPriv*: first contract in 1990 or later) are lower than costs in municipalities with public production (negative sign). This difference is significant at the 5 per cent level. On the other side, we find that costs in the municipalities with private production and old reform (*OldPriv*: first contract before 1990) are higher than costs in the municipalities with public production (positive sign). In this case, however, the difference is

[12] It has to be noted that now the sample has been reduced to 125 municipalities, since we do not have the information on the year of first contracting for 61 municipalities with private production.

not statistically significant. Finally, when comparing Old with New privatization (last row in table 9), we find that costs with old privatization are higher than costs with new privatization, and this difference is significant at the 5% level.

These results clearly show the weakness of competition in the sector, and they suggest that competition failures can be particularly important in the municipalities where the first contract took place long time ago. Thus, all this can contribute to explaining why contracting out has no significant effects on the payments borne by municipalities when we analyze the whole sample of municipalities.

CONCLUSIONS

This paper studies the effects of contracting out on waste collection costs. To this aim, an explanatory model on municipal refuse collection costs is specified and estimated, using a sample on Spanish municipalities. Indeed, this paper presents the first empirical parametrical evidence on this issue for this country. Results obtained in the estimation indicate no significant effects of the mode of production on costs borne by municipalities.

As we do not find any significant effect of the mode of production (public/private) on costs, we put forward two hypotheses. On one hand, the threat that privatization may represent for public unit managers may have stimulated them to search for alternative management reforms, as inter-municipal cooperation and bureaucratic division transformation into a more flexible publicly-owned private-law corporation. On the other hand, progressive concentration and bidding competition decrease in the privatized sector may have outweighed eventual gains coming from privatization.

Results obtained in the cost comparison between the case when inter-municipal cooperation is taken and the case when it is not so, reveal that this tool may be good to exploit scale economies and hence reduce costs in municipalities with a population lower than 20,000 habitants. Regression analysis confirms these results for inter-municipal cooperation. Given that this kind of service aggregation is much more usual in non-privatizing municipalities, one can conclude that inter-municipal cooperation is often used as an alternative to privatization in order to reduce costs.

Market concentration in the solid waste collection sector is quite intensive. Results obtained from the analysis show a clear weakness of competition in the sector, and give support to the hypothesis that lack of competition is an explanation for the non-existence of privatization-induced cost advantage. Evidence on the time when privatization took place first suggest that the more recent the reform the better its effect on costs. Nonetheless, when the

first privatization took place long ago, the costs for the service tend to be higher. That may help to explain why the mode of production has no significant effect on costs paid by municipalities when we analyze the whole sample of municipalities.

From the empirical results, we derive some important implications for solid waste collection management. It is worth mentioning that reform policies already implemented, by contracting out or by inter-municipal cooperation, may have been decisive to almost completely exploited scale economies. It is also useful to point out that contracting out dynamics may have been presenting serious competition failures. By promoting antitrust policies, efficiency gains and cost reductions could be redirected to municipalities. Pro-competition political agendas, hardly ever concerned about public service concessions, should take note of it.

REFERENCES

REFERENCES

Alcaide Inchausti, Julio and Pablo Alcaide Guindo (2003). *Balance económico regional (Autonomías y Provincias). Años 1995 a 2002.* Madrid: Funcas.

Antonioli, Barbara, and Massimo Filippini (2002). Optimal size in the waste collection sector. *Review of Industrial Organization.* **20**(3):239-252.

Ballard, Michael J. and Mildred E. Warner (2000). 'Taking the high road: Local government restructuring and the quest for quality'. Cornell Working Papers in Planning # 194. Ithaca (NY): Cornell University, (http://www.cce.cornell.edu/restructuring/)

Bel, Germà (2003). 'A full inspection on the cost structure of solid waste services'. WP Collection, E03/107. Barcelona: U. Barcelona, (http://www.ub.es/div2/recerca/documents/papers/107.pdf)

Bel, Germà and Antonio Miralles (2003). Factors influencing privatisation of urban solid waste collection in Spain, *Urban Studies*. **40**(7):1323-1334.

Besanko, David, David Dranove and Mark Shauley (2000). *The Economics of Strategy.* New York (NY): John Wiley & Sons.

Bodkin, Ronald G. and David W. (1971). Scale and other determinants of municipal government expenditures in Ontario: A quantitative analysis, *International Economic Review*. **12**(3):465-481.

Bosch, Nuria, Francisco Pedraja and Suárez-Pandiello, Javier (2000). Measuring the efficiency of Spanish municipal refuse collections services, *Local Government Studies*. **26**(3):71-90.

Boyne, George A. (1998). *Public Choice theory and local government: A comparative analysis of the UK and the USA.* New York (NY): St. Martin's Press.

Boyne, George A. (2000). Public and private management: What's the difference, *Journal of Management Studies*. **39**(1):97-122.

Brown Trevor L. and Matthew Potoski (2003). Managing contract performance: A transaction cost approach, *Journal of Policy Analysis and Management*. **22**(2):275-297.

Callan, Scott J. and Janet M. Thomas (2001). Economies of scale and scope: A cost analysis of municipal solid waste services, *Land Economics*. **77**(3):548-560.

Christoffersen, Henrik and Martin Paldam (2003). Markets and municipalities: A study of the behaviour of the Danish municipalities, *Public Choice*. **11**(2):79-102.

Collins J. N. and Downes B. T. 1977. The effect of size on provision of public services: The case of solid waste collection in smaller cities, *Urban Affairs Quarterly*. **12**(3):333-347.

Cubbin, John, Simon Domberger and Shirley A. Meadowcroft (1987). Competitive tendering and refuse collection: Identifying the sources of efficiency gains, *Fiscal Studies*. **8**(3):49-58.

Dijkgraaf, Elbert and R. H. J. M. Gradus (2003). Cost savings of contracting out refuse collection, *Empirica*. **30**(2):149-161.

Dijkgraaf, Elbert., R. H. J. M. Gradus and Bertrand Melenberg (2003). Contracting out refuse collection, *Empirical Economics*. **28**(3):553-570.
Domberger, Simon and Paul Jensen (1997). Contracting out by the public sector: theory, evidence, prospects, *Oxford Review of Economic Policy*. **13**(4):67-78.
Domberger. Simon, Shirley A. Meadowcroft, and David J. Thompson (1986). Competitive tendering and efficiency: The case of refuse collection, *Fiscal Studies*. **7**(4):69-87.
Domberger, Simon and Stephen Rimmer (1994). Competitive tendering and contracting in the public sector: A survey, *International Journal of the Economics of Business*. **1**(3):439-453.
Donahue, John D. (1989). *The Privatization Decision. Public Ends and Private Means.* New York (NY)*:* Basic Books.
Dubin, Jeffrey A. and Peter Navarro (1988). How markets for impure public goods organize: the case of household refuse collection, *Journal of Law, Economics and Organization*. vol.**4**(2):217-241.
Glaeser, Edward (2001). 'Public ownership in the American city'. Working Paper Nº. 8613, NBER.
Gómez-Lobo, Andres and Stefan Szymanski (2001). A law of large numbers: Bidding and compulsory tendering for refuse collection contracts, *Review of Industrial Organization*. **18**(1):105-113.
Greene William H. (2000) *Econometric Analysis.* Upper Saddle River (NJ): Prentice Hall, 4th ed.
Feigenbaum, Harvey, Jeffrey Henig and Chris Hammett (1999). *Shrinking the state. The political underpinnings of privatization.* New York (NY): Cambridge University Press.
Hefetz, Amir and Mildred Warner (2004). Privatization and its reverse: Explaining the dynamics of the government contracting process, *Journal of Public Administration Research and Theory*. **14**(2):171-190.
Hirsch, Werner Z. (1965). Cost functions of an urban government service: refuse collection, *Review of Economics and Statistics*. **47**(1):87-92.
Hirschman, Albert O. (1971). *A Bias for Hope: Essays on Development and Latin America.* Yale University Press.
Hodge, Graeme A. (2000). *Privatization. An international review of performance.* Boulder (Co): Westview Press.
Kemper, Peter and John and Quigley (1976). *The Economics of Refuse Collection.* Cambridge (Mass): Ballinger.
Kinnaman, Thomas C. and Don Fullerton (2000). Garbage and recycling with endogenous local policy, *Journal of Urban Economics*. **48**(3):419-442.
Kitchen, Harry M. (1976). A statistical estimation of an operating cost function for municipal refuse collection, *Public Finance Quarterly*. **4**(1):56-76.
Kodrzycki, Yolanda K. (1994). Privatization of local public services: lessons for New England, *New England Economic Review.* May/June, 31-46.
Ladd, Helen F. (1992). Population growth, density and the costs of providing public services, *Urban Studies*. **29**(2):273-295.
Lopez-de-Silanes, Florencio, Andrei Shleifer and Robert W. Vishny (1997). Privatization in the United States, *Rand Journal of Economics*. **28**(3):447-471.
McDavid, James C. (1985). The canadian experience with privatizing residential solid waste collection services, *Public Administration Review*. **45**(5):602-608.
McDavid, James C. (2000). Alternative service delivery in Canadian local governments: The costs of producing solid waste management services, *Canadian Journal of Regional Science*. **23**(1):157-174.
McDavid, James C. (2001). Solid-waste contracting-out, competition, and bidding practices among Canadian local governments, *Canadian Public Administration*. **44**(1):1-25.
McGuire, Robert. A., Robert L. Ohsfeldt and T. Norman Van Cott (1987). The determinants of the choice between public and private production of publicly funded service, *Public Choice*. **54**(3):211-230.
McGuire, Robert A., Robert L. Ohsfeldt and T. Norman Van Cott (1990). More on the choice between public and private production of publicly funded service, *Public Choice*. **66**(2):189-194.
Minicucci, Stephen and John D. Donahue (2004). A simple estimation method for aggregate government outsourcing, *Journal of Policy Analysis and Management*. **23**(3):489-507.
Miralles, Antonio (2004). Factors determining municipal water service privatization in the Spanish democratic system (1979-2002): a duration model approach. Universitat de Barcelona, mimeo.

Ohlsson, Henry (2003). Ownership and production costs. Choosing between public production and contracting-out in the case of Swedish refuse collection, *Fiscal Studies*. **24**(4):451-476.
Paroush, Jacob and Jonas Prager (1999). Criteria for contracting-out decisions when contractors can deceive, *Atlantic Economic Journal*. **27**(4):376-383.
Pommerehne, Werner W. and Bruno S. Frey (1977). Public versus private production efficiency in Switzerland: A theoretical and empirical comparison, in: Vincent Ostrom and Francis Pennell Bish (eds.), *Comparing urban service delivery systems*, *Urban Affairs Annual Review*, 12. Beverly Hills, CA: Sage Publications: 221-241
Reeves, Eoin and Michael Barrow (2000). The impact of contracting-out on the costs of refuse collection services.The case of Ireland, *Economic and Social Review*. **31**(2):129-150.
Reimer, Suzanne (1999). Contract Service Firms in Local Authorities: Evolving Geographies of Activity, *Regional Studies*. **33**(2):121-130.
Sappington, David and Joseph E. Stiglitz (1987). Privatization, information and incentives, *Journal of Policy Analysis and Management*. **6**(4):567-957.
Savas, Emmanuel S. (1977). Policy analysis for local government: Public vs. Private refuse collection, *Policy Analysis*. **3**(1):49-74.
Savas, Emmanuel S. (1981). Intracity competition between public and private service delivery, *Public Administration Review*. **41**(1):46-52.
Savas, Emmanuel S. (2000). *Privatization & Public-Private Partnerships*. New York (NY): Chatham House.
Sclar, Elliot (1997). *The privatization of public service: Lessons from case studies.* Washington DC: Economic Policy Institute.
Sclar, Elliot (2000). *You don't always get what you pay for: The economics of privatization.* London: Cornell University Press.
Stevens, Barbara J. (1978). Scale, market structure, and the cost of refuse collection, *Review of Economics and Statistics*. **60**(3):438-448.
Szymanski, Stefan (1996). The impact of compulsory competitive tendering on refuse collection services, *Fiscal Studies*. **17**(3):1-19.
Szymanski, Stefan and Sean Wilkins (1993). Cheap rubbish? Competitive tendering and contracting out in refuse collection, *Fiscal Studies*. **14**(3):109-130.
Tickner, Glen and James C. McDavid (1986). Effects of scale and market structure on the costs of residential solid waste collection in Canadian cities, *Public Finance Quarterly*. **14**(4):371-393.
Vickers, J. and Yarrow, G. (1991). Economic perspectives on privatisation, *Journal of Economic Perspectives*. **5(**2):111-132.
Warner, M. and Hebdon, R. (2001). Local government restructuring: privatization and its alternatives, *Journal of Policy Analysis and Management*. **20**(2):315-336.
Warner, M. and Hefetz, A. (2001). *Privatization and the market role of local government.* Washington DC: Economic Policy Institute.
Warner, M. and Hefetz A. (2003). Rural – urban differences in privatization: limits to the competitive state, *Environment and Planning C: Government and Policy*. **21**(4):703-718.

Appendix

Table A-1. Representativeness of sample.

Municipalities included in the analysis					
Population	1000-5999	5000-9999	10000-19999	≥ 20000	Total ≥ 1.000
Municipalities	89	32	26	39	186
Percent on total	34.9	44.4	57.8	79.6	44.2
Population	218,544	233,870	368,415	3,945,521	4,766,350
Percent on total	37.6	47.9	58.4	90.9	78.9

Source: Survey on the Production of Local Public Services (UB)

Tabla A-2. The structural change test

Equation	n	k	Residual Squared Summa	Degrees of freedom
All municipalities (restricted)	186	9	$11.861 = S_0$	177
Municipalities < 20.000 inhabitants (non r_1)	147	9	$9.629 = S_{1,1}$	138
Municipalities ≥ 20.000 o inhabitants (no r_2)	39	9	$0.523 = S_{1,2}$	30

On the basis of these data we can apply the F-Test :

$$F = \frac{(S_0 - \Sigma S_{1,i}) / [(n-k)-(n-2k)]}{\Sigma S_{1,i} / (n-2k)} = 3.10 > 2.41 = F_{0.99\,(9,168)}$$

Table A-3. Firms, concessions and market structure

Concessions per firm	Firm	Total number of concessions	Share in concessions (per cent)	Waste collected (Tn)	Average waste collected per concession (Tn)	Share in waste collected (per cent)
46	FCC	46	29.68	1,069,516.37	23,250.36	46.86
18	CESPA	18	11.61	371,923.36	20,662.41	16.30
8	Vicens Orts	8	5.16	52,025.43	6,503.18	2.28
7	BF-Iacsa	7	4.52	65,779.01	9,397.00	2.88
4	Urbaser	4	2.58	201,879.53	50,469.88	8.85
4	Ferran Vila	4	2.58	13,538.30	3,384.58	0.60
3	3 empresas	9	5.81	42,729.86	4,747.76	1.87
2	10 firms	20	12.90	153,160.03	7,658.00	6.71
1	39 firms	39	25.16	311,766.46	7,994.01	13.66
		155	100.00	2,282,318.34	14,724.63	100.00

Note: When there is a holding with several firms, the concessions hold by subsidiary firms have been integrated with concessions obtained by the leading firm in the holding.